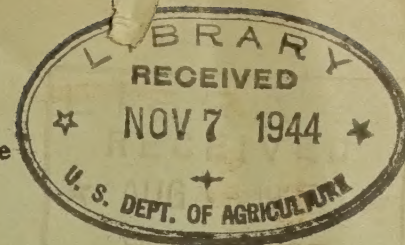


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THE INTRODUCTION AND COLONIZATION IN PUERTO RICO OF BENEFICIAL
INSECTS PARASITIC ON THE PINK BOLLWORM OF COTTON

BY

KENNETH A. BARTLETT, ASSISTANT ENTOMOLOGIST,
DIVISION OF FOREIGN PARASITE INTRODUCTION,
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE,
UNITED STATES DEPARTMENT OF AGRICULTURE A

THE PINK BOLLWORM PROBLEM

THE BOLLWORM IS AN IMPORTANT FACTOR IN LONG-STAPLE COTTON PRODUCTION.

THE PINK BOLLWORM, PECTINOPHORA GOSSYPIELLA SAUNDERS, IS AN IMPORTANT FACTOR IN THE PRODUCTION OF SEA ISLAND COTTON IN PUERTO RICO. THE EGG OF THIS INSECT IS USUALLY LAID ON THE SMALL LEAVES SURROUNDING THE BOLL AND AT TIMES ON THE LEAVES OF THE PLANT. THE LARVA HATCHES AND ENTERS THE BOLL, WHERE IT FEEDS ON THE COTTON LINT AND SEEDS. AS A RESULT THE FIBERS ARE CUT AND STAINED WITH A RESULTING LOSS IN VALUE. THE PERCENTAGE OF INFESTED BOLLS IN HEAVILY INFESTED FIELDS MAY RUN AS HIGH AS 100 WITH FOUR OR FIVE LARVAE PER BOLL, SERIOUSLY AFFECTING THE PRICE WHICH MAY BE OBTAINED FOR SUCH COTTON.

THESE NOTES GIVE A SUMMARY OF THE PROGRAM TO OBTAIN BIOLOGICAL CONTROL INITIATED AGAINST THE PINK BOLLWORM. THEY ARE THE RESULTS OF STUDIES CONDUCTED BY THE AUTHOR FROM JULY 1935 TO OCTOBER 1936. THE INVESTIGATIONS WERE FINANCED INITIALLY UNDER PUERTO RICO SUGAR-PROCESSING TAX FUND, ORDER NUMBER 2, AND LATER WITH FEDERAL FUNDS APPROPRIATED FOR THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE. THE HEADQUARTERS FOR THIS WORK WERE LOCATED AT THE PUERTO RICO EXPERIMENT STATION, MAYAGUEZ,

A NOW ASSOCIATE ENTOMOLOGIST, PUERTO RICO EXPERIMENT STATION,
UNITED STATES DEPARTMENT OF AGRICULTURE.

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AND THE AUTHOR WISHES TO TAKE THIS OPPORTUNITY TO EXPRESS HIS APPRECIATION OF THE FACILITIES PROVIDED BY THE EXPERIMENT STATION.

MORE THAN 58,000 PARASITES OF THE PINK BOLLWORM HAVE BEEN INTRODUCED INTO PUERTO RICO.

THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, THROUGH THE DIVISION OF COTTON INSECT INVESTIGATIONS AND THE DIVISION OF FOREIGN PARASITE INTRODUCTION, SHIPPED TO PUERTO RICO DURING THE PAST YEAR THREE MAJOR PARASITES OF THE PINK BOLLWORM FROM ITS LABORATORY AT PRESIDIO, TEXAS. TWO OF THE SPECIES HAD BEEN INTRODUCED INTO THE UNITED STATES FROM EGYPT AND THE OTHER FROM HAWAII. WHILE THESE LARGE SHIPMENTS OF BENEFICIAL INSECTS WERE READILY ASSEMBLED FOR INTRODUCTION TO PUERTO RICO, IT SHOULD BE NOTED THAT CONSIDERABLE PREVIOUS WORK CARRIED ON IN YEARS PAST BY THE UNITED STATES DEPARTMENT OF AGRICULTURE MADE SUCH A PROGRAM POSSIBLE. THE INITIAL EXPLORATION IN FOREIGN LANDS, THE IMPORTATION, AND THE PERFECTION OF A BREEDING TECHNIQUE BY THE DEPARTMENT ARE ALL MAJOR FACTORS WHICH MADE SUCH INTRODUCTIONS TO PUERTO RICO POSSIBLE.

FOUR SHIPMENTS OF PARASITE MATERIAL WERE SENT FROM PRESIDIO, TEXAS TO PUERTO RICO IN 1935 AND 1936. THREE OF THESE SHIPMENTS WERE MADE BY AIR EXPRESS AND ONE BY PARCEL POST IN THE USUAL MAIL CHANNELS. THE SHIPMENTS WERE ASSEMBLED UNDER THE DIRECTION OF A. J. CHAPMAN AND L. W. NOBLE OF THE PRESIDIO LABORATORY IN TEXAS, AND A TECHNICALLY TRAINED MAN WAS EMPLOYED BY THEM AT THE LABORATORY FROM FUNDS MADE AVAILABLE FROM THE PROCESSING-TAX ALLOTMENT FOR THIS WORK. THE DATES, NUMBERS OF INDIVIDUALS, AND DETAILS OF SUCH INTRODUCTIONS ARE SHOWN IN TABLE I.

TABLE I.—A LIST OF BENEFICIAL INSECT SPECIES INTRODUCED INTO PUERTO RICO DURING 1935-36 FROM PRESIDIO, TEXAS, TO COMBAT THE PINK BOLLWORM, WITH DATES OF INTRODUCTION, NUMBERS OF INDIVIDUALS, AND THEIR COUNTRIES OF ORIGIN.

DATES	NUMBERS	SPECIES	ORIGINAL COUNTRY OF ORIGIN
OCT. 24, 1935	15,000	<u>MICROBRACON KIRKPATRICKI</u>	EGYPT
OCT. 24, 1935	2,000	<u>EXERISTES ROBORATOR</u>	EGYPT
OCT. 31, 1935	25,500	<u>MICROBRACON KIRKPATRICKI</u>	EGYPT
MAY 16, 1936	14,064	<u>CHELONUS BLACKBURNI</u>	HAWAII
MAY 19, 1936	1,980	<u>EXERISTES ROBORATOR</u>	EGYPT

MICROBRACON KIRKPATRICKI WAS SHIPPED IN THE COCOON STAGE AND EXERISTES ROBORATOR AS FULL-FED MATURE LARVAE, WHILE CHELONUS BLACKBURNI WAS SENT IN PARASITIZED LARVAE OF THE GRAIN MOTH EPHESTIA KUEHNIELLA THAT WERE USED AS LABORATORY HOSTS.

LIFE HISTORIES OF THE THREE IMPORTED SPECIES.

THE THREE IMPORTED SPECIES ARE ALL TRUE PARASITES OF THE PINK BOLLWORM AND BELONG TO THE ORDER HYMENOPTERA. THEIR HABITS OF REPRODUCTION CAN BE OUTLINED BRIEFLY AS FOLLOWS: THE FEMALE OF CHELONUS BLACKBURNI DEPOSITS HER EGG IN THE EMBRYO OF THE EGG OF THE PINK BOLLWORM. THE YOUNG PARASITE LARVA FEEDS WITHIN THE BODY OF ITS HOST LARVA UNTIL THE LATTER HAS SPUN ITS COCOON. THE CONSTANT FEEDING ON THE BODY FLUIDS AND FINALLY ON THE VITAL ORGANS KILLS THE BOLLWORM, AFTER WHICH THE PARASITE LARVA, NOW FULLY GROWN, EATS ITS WAY OUT AND THE FULL-FED PARASITE LARVA PUPATES AND IN A SHORT TIME EMERGES AS A SMALL STOCKY WASP. THE TIME INTERVAL FOR THE COMPLETION OF THE LIFE HISTORY OF C. BLACKBURNI UNDER PUERTO RICAN CONDITIONS IS NOT KNOWN YET.

EXERISTES ROBORATOR AND MICROBRACON KIRKPATRICKI HAVE HABITS OF PARASITISM WHICH ARE MORE OR LESS SIMILAR. THE FEMALE OF THIS SPECIES SEEKS OUT THE PINK BOLLWORM LARVA AND WHEN ONE IS FOUND THE PARASITE STINGS IT AND THIS RESULTS IN PARALYSIS OF THE HOST LARVA; RECOVERY FROM THIS PARALYSIS RARELY, OR NEVER, OCCURS. THE FEMALE THEN ATTACHES HER EGG TO THE OUTSIDE OF THE BODY OF THE PARALYZED PINK BOLLWORM. THE SMALL PARASITE LARVA THAT HATCHES IN A FEW DAYS FEEDS EXTERNALLY ON THE PINK BOLLWORM LARVA. THE PARASITE LARVA WILL REACH ITS FULL DEVELOPMENT DURING ITS FEEDING UPON THE HOST INSECT AND WILL THEN PUPATE. THE PARASITE ADULTS ON EMERGENCE CONTINUE THEIR ATTACKS ON THE PINK BOLLWORM.

LIBERATIONS OF IMPORTED BENEFICIAL INSECTS WERE MADE IN COTTON-GROWING AREAS INFESTED WITH PINK BOLLWORM.

THE AREAS IN WHICH THE PINK BOLLWORM PARASITES WERE LIBERATED WERE SELECTED FROM INFORMATION SECURED BY L. C. FIFE, OF THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, IN CHARGE OF COTTON INSECT INVESTIGATIONS IN PUERTO RICO. LIBERATION POINTS WERE SELECTED PRIMARILY ON THE BASIS OF AMOUNT OF INFESTATION BY THE PINK BOLLWORM, PROXIMITY OF THESE POINTS TO THE COTTON-GROWING AREAS AS A WHOLE, AND THE ADVANTAGES OF TOPOGRAPHICAL AND ENVIRONMENTAL INFLUENCES FOR THE FURTHER SPREAD OF THE PARASITES. THE DETAILS AS TO THE PLACES AND DATES OF LIBERATION OF THESE BENEFICIAL INSECTS ARE SHOWN IN TABLE 2.

TABLE 2.--THE LIBERATIONS OF INSECT SPECIES PARASITIC ON THE PINK BOLLWORM IN PUERTO RICO, INTRODUCED FROM PRESIDIO, TEXAS, DURING 1935-36, WITH DATES, LOCALITIES, AND THE NUMBERS LIBERATED.

LIBERATION POINTS AND DATES	SPECIES OF PINK BOLLWORM PARASITES LIBERATED			TOTAL INDIVIDUALS LIBERATED
	<u>CHELONUS</u> <u>BLACKBURNI</u>	<u>EXERISTES</u> <u>ROBORATOR</u>	<u>MICROBRACON</u> <u>KIRKPATRICKI</u>	
	<u>NUMBERS</u>	<u>NUMBERS</u>	<u>NUMBERS</u>	<u>NUMBERS</u>
CAMUY, BARRIO MEMBRILLO FIELDS OF F. MARTINEZ OCT., 1935	----	1592	13,541	15,133
CAMUY, BARRIO PUEBLO FIELDS OF F. N. GUILLANA NOV., 1935	----	----	21,987	21,987
ISABELA, BARRIO PATILLO, MAY TO JULY, 1936	13,586	1251	----	14,837
TOTALS	13,586	2843	35,528	51,957

THE LIBERATION AT ISABELA WAS MADE IN COTTON FIELDS ON THE NORTH SIDE OF INSULAR ROAD No. 2, BETWEEN KILOMETER POSTS 119 AND 121 NORTHWARDS FROM THE ROAD TOWARD THE SEASHORE.

ALL OF THE PARASITES WERE LIBERATED AS ADULTS, THESE HAVING BEEN REARED OUT IN THE LABORATORY AT THE EXPERIMENT STATION AT MAYAGUEZ FROM IMMATURE STAGES RECEIVED FROM TEXAS.

ONLY ONE NATIVE PARASITE OF THE PINK BOLLWORM HAS BEEN FOUND IN PUERTO RICO.

THE ONLY NATIVE INSECT PARASITE WHICH HAS BEEN REARED TO DATE FROM COLLECTIONS OF PINK BOLLWORMS IN THE ISLAND IS PERISIEROLA SP., NEAR NIGRIFEMUR. IT IS LIKELY THAT THIS SPECIES HAS NOT YET BEEN DESCRIBED. THIS PARASITE IS AN EXTERNAL FEEDER AND SEVERAL INDIVIDUALS DEVELOP ON A SINGLE HOST. THE PERCENTAGE OF PARASITIZATION DURING THE PAST YEAR HAS BEEN NEGLIGIBLE AND THIS SPECIES APPARENTLY DOES NOT PLAY AN IMPORTANT PART IN THE BIOLOGICAL CONTROL OF THE BOLLWORM.

ALL LIBERATED SPECIES HAVE BEEN RECOVERED.

COLLECTIONS OF COTTON BOLLS INFESTED WITH THE PINK BOLLWORM HAVE BEEN MADE IN THE VICINITY OF LIBERATION POINTS AT VARIOUS TIMES SINCE THE RELEASE OF THE PARASITES. WHILE THE NUMBER OF INDIVIDUAL PARASITES THUS RECOVERED HAS BEEN SMALL, THE COLONIZATIONS SEEM ASSURED OF INITIAL SUCCESS, AND IT IS HOPED THAT THOROUGH ESTABLISH-

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